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B71 02035

SUBJECT: Contingency Activation of the Apollo Telescope Mount - Case 620

DATE: February 18, 1971

FROM: S. H. Levine

MEMORANDUM FOR FILE

[redacted]

Introduction

The current design of the ATM provides the capability for "unmanned" operation of selected ATM experiments only after initial systems activation by the crew. This memorandum describes the changes required to extend this capability to the period prior to the arrival of the first crew. Incorporation of this concept would allow the acquisition of valuable scientific data from the ATM in the event a long delay occurs prior to crew arrival and subsequent manned activation of the SWS. The changes proposed provide the capability for ground control of those functions normally initiated by the crew during activation.

Current "Unmanned/Unattended" Capabilities

It is currently possible to operate particular ATM experiments in either the "unmanned" or "unattended" mission modes only after initial manned activation of the orbital assembly. Functions that must be performed by the crew at the ATM C&D Console before unmanned or unattended operations can be conducted are:

1. Disengagement of ATM experiment package launch locks,
2. Rotation of the Experiment Package,
3. Disengagement of the S055A Mirror Launch Lock, and
4. Resetting of ATM C&D Console Switches to the "unmanned/unattended" configuration.

After these functions have been performed by the crew, it is possible for ground initiated RF commands to control ATM experiment package pointing in both sun-centered and offset positions. In addition, RF ground commands are provided for control of selected experiment and systems functions that will allow collection of scientific data during unmanned periods between crew visits and when the

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ATM C&D Console is unattended. The experiments that can be operated in this manner are:

Experiment Title	Scientific Data-Unmanned Capability
S052 White Light Coronagraph (HAO)	Photographic data - 8025 frames, max.
S054 X-Ray Spectrographic Telescope (AS&E)	Photographic data - 6000 frames, max. and telemetry data (flare alert-photomultiplier & X-Ray pulse height analyzer).
S055A Scanning UV Polychromator Spectroheliometer (HCO)	Telemetry data (polychromatic use of 7 photomultipliers or wavelength vs. intensity scans across one photomultiplier).
*S082A XUV Coronal Spectroheliograph (NRL)	Photographic data - Spectroheliograms of total sun - 200 strip exposures.

*Capability exists but usage is not planned.

ATM Experiments Contingency Operation

In order to provide the capability to operate the selected ATM experiments in an unmanned mode prior to the arrival of a crew, the following changes to ATM systems and procedures are required.

1. Launch Configuration - The ATM Control & Display (C&D) Console must be preset in the appropriate "unmanned" mission configuration prior to the launch of SL-1 (see Table 1).

2. Experiment Package Launch Locks - The ATM experiment package gimbals are secured to the rack structure during the launch phase of SL-1 to prevent relative motion in pitch, yaw, and roll between the rack and the experiment package. Sets of spring loaded launch locks are located on the periphery of the experiment package, where each leg of the cruciform spar intersects the girth ring (see Figure 1). Crew activation of "arm" and "fire" switches on the ATM C&D Console (see Figure 2a) initiates pin-pulling ordnance devices that in turn retract the launch lock struts to their stowed position. Use of two spare switch selector channels (see Table 2) would allow the

ground to remotely retract these struts by RF command. Figure 3 indicates that implementation of these digital command system (DCS) functions would probably require only minor networks changes involving the addition of some interbox wiring between switch selector #1 and the power transfer distributor as well as some minor changes to the distributor. This change would only be applicable for a contingency mode of operation of the SWS and therefore requires only simplexed implementation. No changes are required to the ATM C&D Console.

3. Roll ATM Experiment Package - The ATM experiment package is purged with dry nitrogen prior to the launch of SL-1. At launch, the ground umbilical supplying nitrogen to the spacecraft is disconnected and thereafter purge lines connecting the umbilical interface at the payload shroud to the ATM experiment package (via the ATM deployment assembly) remain a part of the SWS assembly. During manned activation of the SWS, the segment of this nitrogen purge line (flex hose) bridging the gap between the ATM experiment package and the ATM rack (see Figure 1) must be disconnected and retracted out of the way before the ATM experiment package can be pointed in pitch, yaw, or roll. This function is performed by crew activation of roll switches located on the ATM C&D Console (see Figure 2b). A clockwise roll (looking sunward) of approximately 15° is required to allow the purge line and its fittings to swing clear. There currently is no capability to perform roll of the ATM experiment package by ground command. In order to accomplish ground commanded roll of the experiment package, roll gain switches on the ATM C&D Console would have to be preset to the desired gain, and two spare channels of switch selector #3 would be used for "roll enable" and "clockwise roll" commands. Figure 4 shows that this capability could be implemented in the system, in simplexed form, with apparently minor networks changes. It should be pointed out that incorporating these functions as part of the unmanned orbital programmed activation of the SWS could prevent potential jamming of the purge line disconnect mechanism that could occur from inadvertant counterclockwise rotation of the experiment package during manned activation of the ATM. This currently represents a single point failure source for all ATM experiment pointing control. No changes are required to the ATM C&D Console.

4. S055A Primary Mirror Launch Locks - The S055A Scanning UV Polychromator Spectroheliometer has a flex pivot gimbal mounted Primary Mirror. Launch locks are incorporated that restrain motions of this mirror during the launch phase. Since this experiment uses the primary mirror to sweep 5 arc min. x 5 arc min. areas of the sun across the entrance slit of the spectrometer, freedom of motion of the mirror is essential to successful operation of the instrument. Use of an existing spare channel of switch selector #4 for unlocking the S055A primary mirror, in place of the crew operated switch function of the ATM C&D Console (see Figure 2a) would provide the ground with RF command control of the S055A launch lock. Introduction of this simplexed command for contingency operations would require only minor changes to ATM networks as seen in Figure 5. No changes are required to the ATM C&D Console.

Summary

Examination of existing systems and operations reveals that by incorporating minor changes to ATM networks design, it would be possible to operate select ATM experiments, and thus return valuable scientific data, while the orbital assembly is unmanned prior to the arrival of SL-2. This capability has particular merit if undue delay occurs to the launch of SL-2.

The system changes required would include the addition of ATM digital command system switch selector simplexed commands using existing spare channels (see Table 2), to perform the following functions:

RF COMMAND FUNCTION REQUIRED	NO. CMDS Req's	NO. SPARE CMDS Avail. ($S/_S$*)
ARM/FIRE EPC LAUNCH LOCKS	2	6 ($S/_S$ #1)
ROLL ENABLE & CLOCKWISE ROLL	2	3 ($S/_S$ #3)
S055A LAUNCH LOCK RELEASE	1	6 ($S/_S$ #4)

*$S/_S$ - Switch Selector

Wiring runs currently exist between the above designated switch selectors and the proposed networks destinations, however, a

small number of conductors may have to be added to these runs. A total of five additional relays would be required in existing distributors to incorporate these changes. No other modifications to ATM hardware, related to this change, appear to be required.

S. H. Levine

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Attachments

TABLE 1

ATM C&D CONSOLE CONFIGURATION

PRESET SWITCH POSITIONS DURING UNMANNED AND UNATTENDED OPERATIONS

	SWITCH	POSITION
S052	MAIN POWER	STBY
	DOOR	CENTER
	AUTO DOOR	NORMAL
	MODE	STANDARD PATROL
	LOW FILM INHIBIT	NORMAL
	START - STOP	CENTER
	THERMAL	ON
	MIRROR POSITION	CENTER
	SCALE	X10
	ALIGN	PTG
	WLC ALIGN (5 POS SW)	CENTER
S054	MAIN POWER	OFF
	DOOR	NEUTRAL
	X-RAY IMAGE	OFF
	IMAGE DISSECTOR	ENABLE (WITH OPTIONS)
	PHOTOMULTIPLIER	ENABLE
	GRATING	OUT
	FILTER	STORAGE
	PICTURE RATE	SINGLE
	FLARE AUTO	INHIBIT
	EXPOSURE RANGE	256 (OPTION FOR AUTO)
	FLARE THRESHOLD (COARSE)	TBD
	FLARE THRESHOLD (FINE)	TBD

PRESET SWITCH POSITIONS DURING UNMANNED AND UNATTENDED OPERATIONS

	SWITCH	POSITION
S054	START-STOP	NEUTRAL
	PHOTOMULTIPLIER, CTR/TEST	NEUTRAL
	THERMAL POWER	OFF
	IMAGE THRESHOLD	256 OR NEUTRAL
	FOCUS	FULL CCW
	BRIGHTNESS	FULL CCW
S055A	MAIN POWER	OFF
	THERMAL	OFF
	MODE SELECTOR	STOP
	H.V. ENABLE/RESET #1	OFF
	H.V. ENABLE/RESET #2	OFF
	H.V. ENABLE/RESET #3	OFF
	H.V. ENABLE/RESET #4	OFF
	H.V. ENABLE/RESET #5	OFF
	H.V. ENABLE/RESET #6	OFF
	H.V. ENABLE/RESET #7	OFF
	MAIN H.V.	ENABLE
	GRATING REF	OPT
	GRATING MOTOR DRIVE	PRIM
	ITEN DATA	OFF
	DET SEL	1
	H.V./DOOR INTLK	NORMAL
	EXP NIGHT INTLK	NORMAL

PRESET SWITCH POSITIONS DURING UNMANNED AND UNATTENDED OPERATIONS

	SWITCH	POSITION
S082A	MAIN POWER	OFF
	POWER/DOORS	NEUTRAL
	THERMAL	OFF
	MODE	AUTO 2
	START/STOP	NEUTRAL
	WAVE LTH	NEUTRAL
	EXPOSURE	NEUTRAL
	FLARE	NEUTRAL

TABLE 2

AVAILABLE SPARE CHANNELS - ATM SWITCH SELECTORS

Switch Selector No.	Command No.	Octal Command Code
1	83 (Spare)	10151
1	84 (Spare)	10131
1	85 (Spare)	10147
1	86 (Spare)	10127
1	93 (Spare)	10045
1	94 (Spare)	10013
3	330 (Spare)	30046
3	331 (Spare)	30171
3	332 (Spare)	30167
4	368 (Spare)	40175
4	413 (Spare)	40027
4	416 (Spare)	40004
4	452 (Spare)	40064
4	453 (Spare	40012
4	454 (Spare)	40113

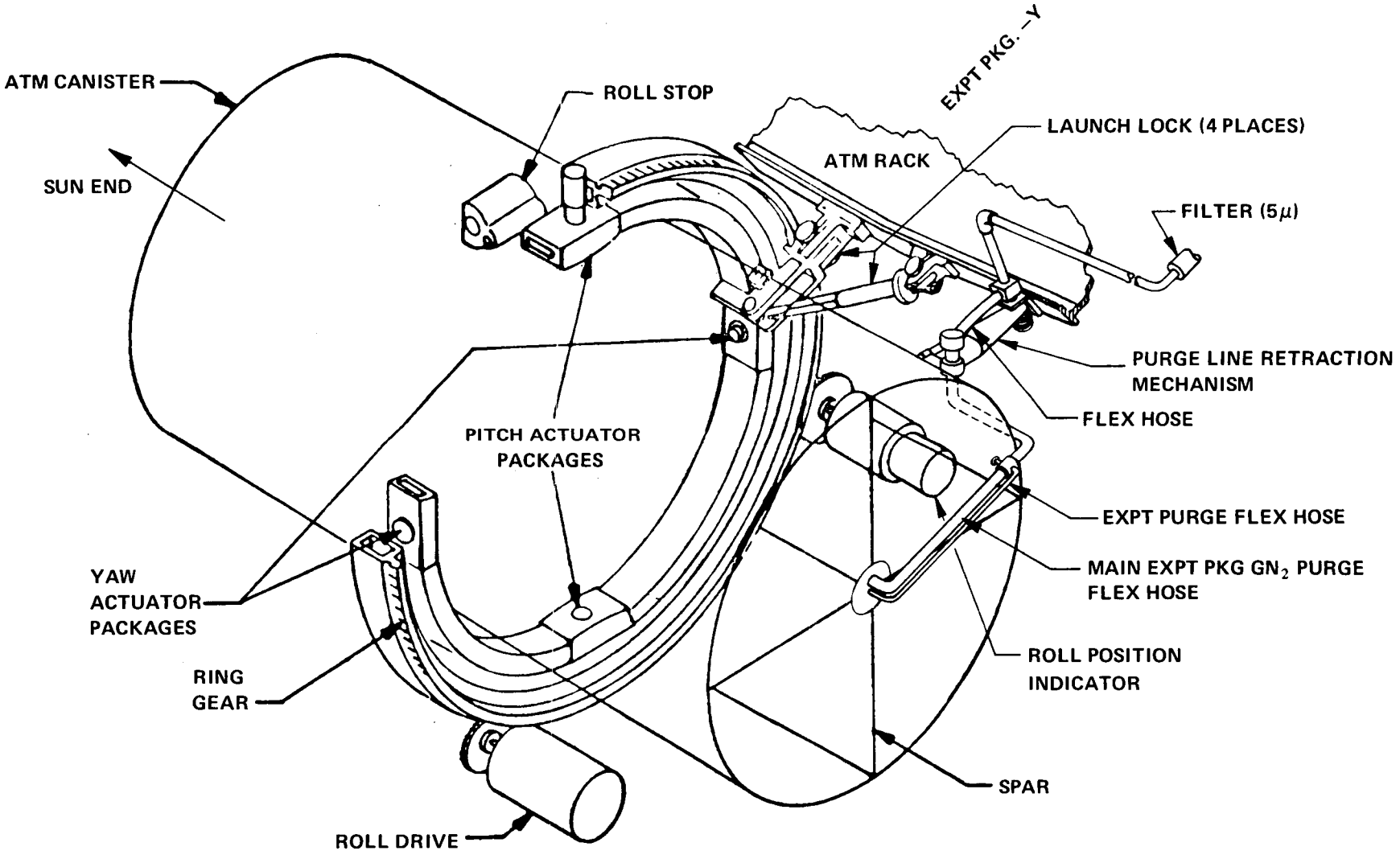

FIGURE 1 - ACTIVATION ATM EXPERIMENT PACKAGE

FIGURE 2 - ATM CONTROL & DISPLAY CONSOLE

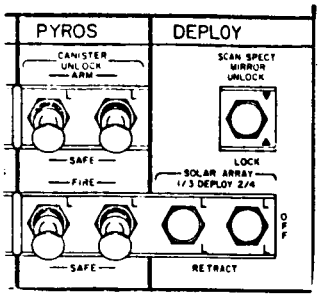

Figure 2a - Pyros Deploy Panel

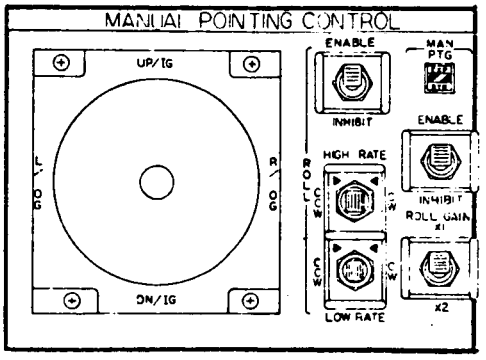

Figure 2b - Manual Pointing Control Panel

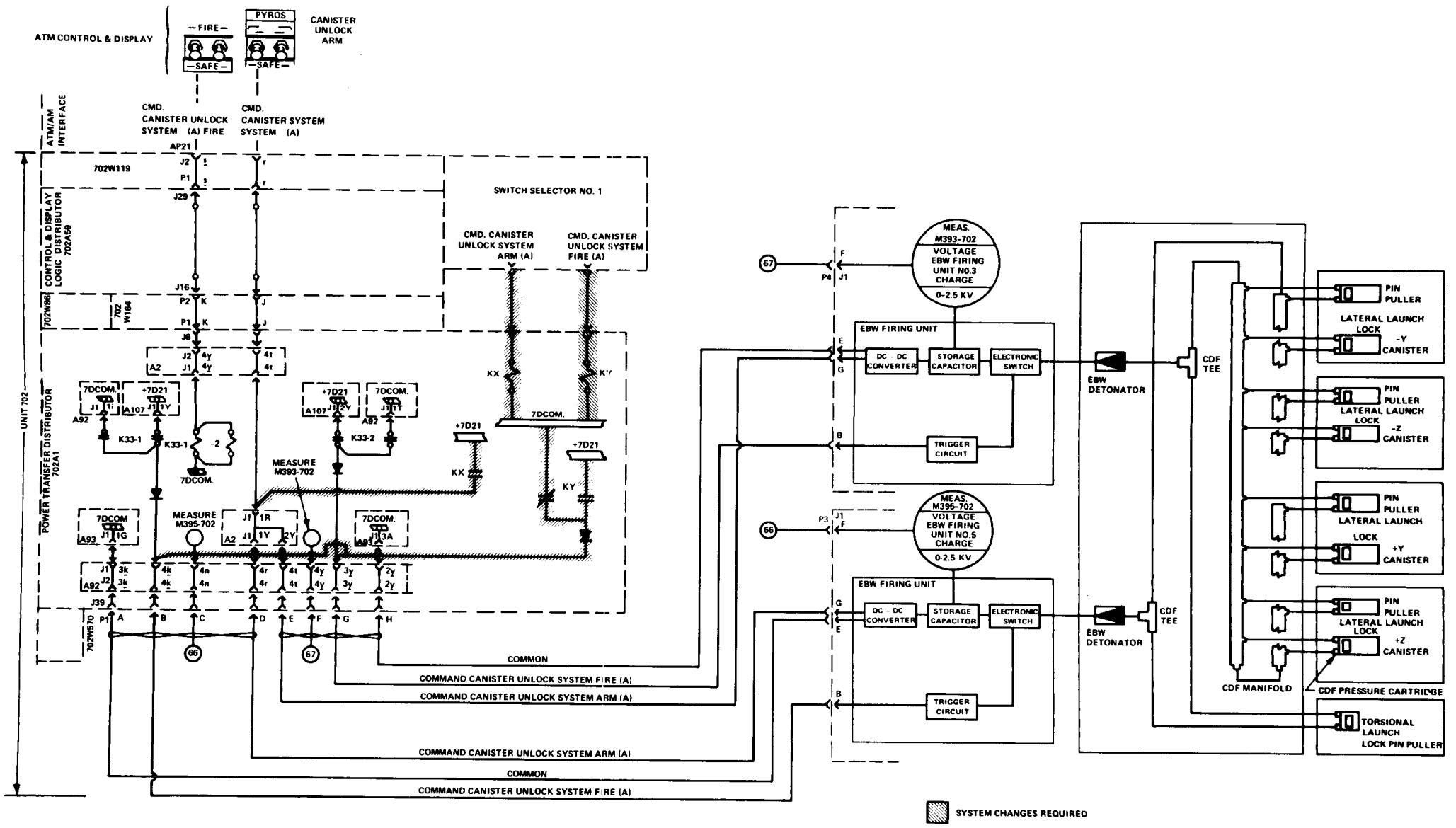

FIGURE 3 - EPC LAUNCH LOCK ACTIVATION SCHEMATIC - UNMANNED CONTINGENCY

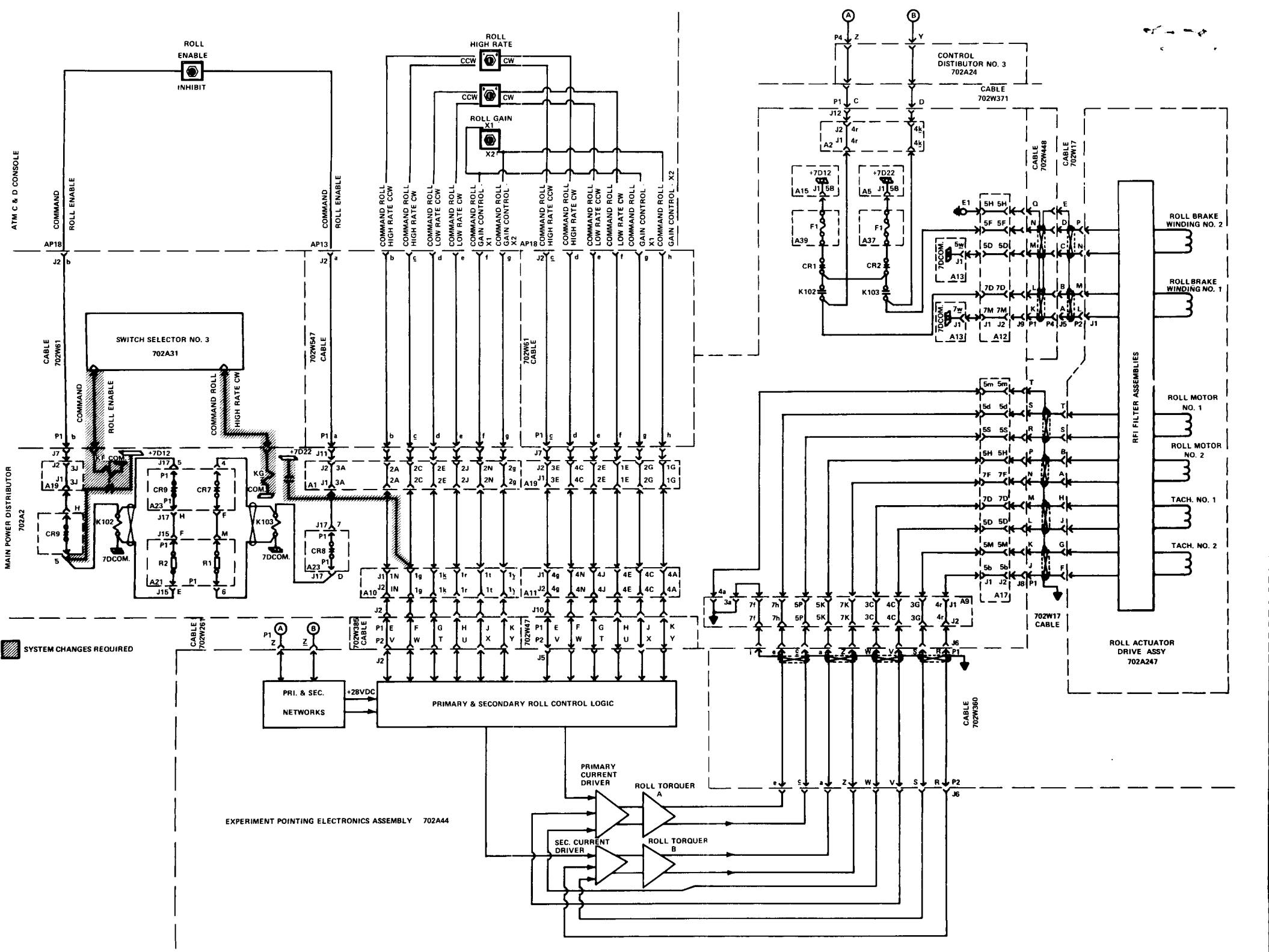

FIGURE 4 - ROLL CONTROL EXPERIMENT PACKAGE - UNMANNED CONTINGENCY

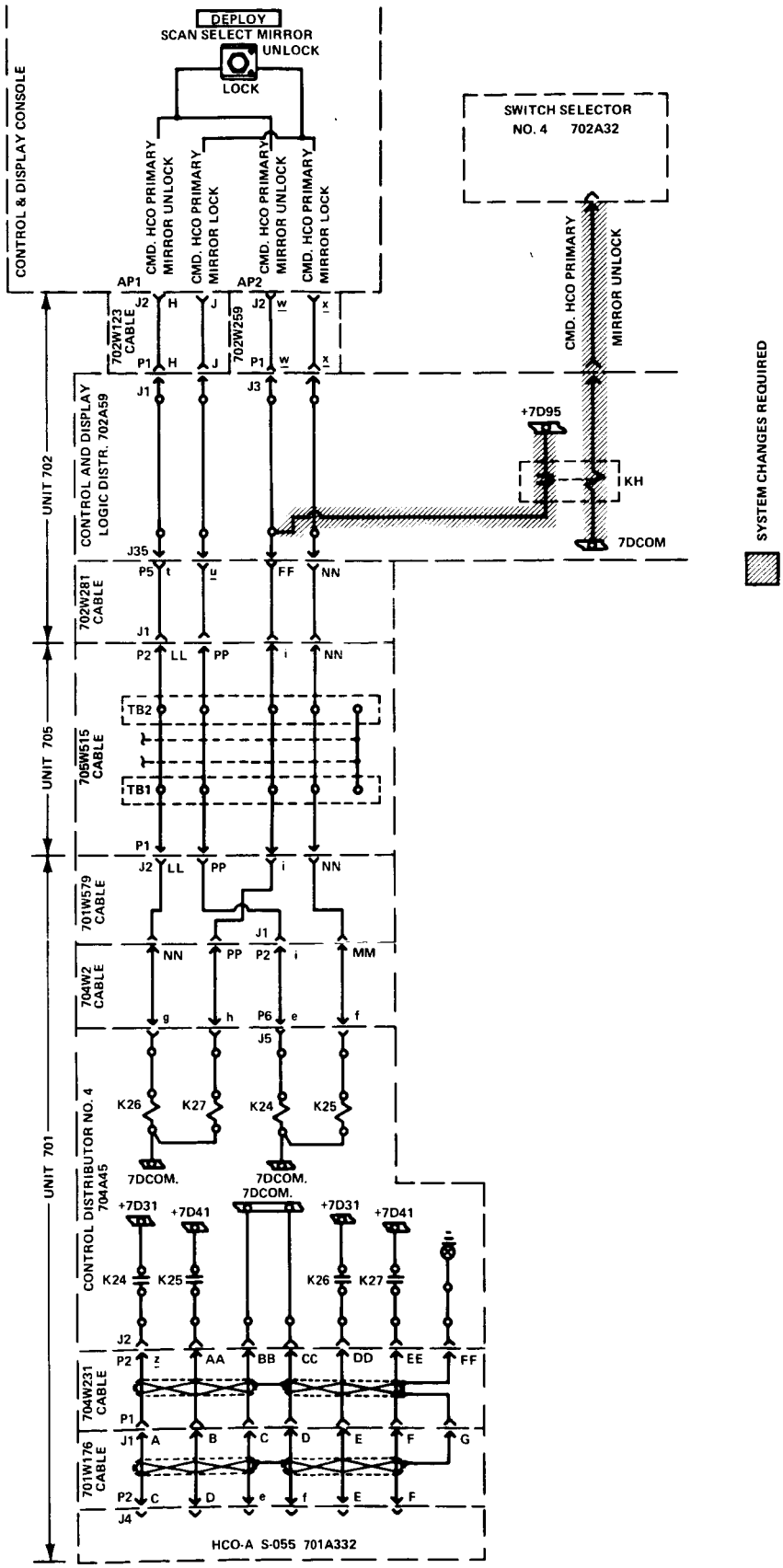

FIGURE 5 - LAUNCH LOCK - HCO EXPERIMENT - UNMANNED CONTINGENCY

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